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Type 2 Fuzzy Inference-Based Time Series Model

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Abstract: Fuzzy techniques have been suggested as useful method for forecasting performance. However, its dependency on experts' knowledge causes difficulties in information extraction and data collection. Therefore, to overcome the difficulties, this research proposed a new type 2 fuzzy time series (T_2FTS) forecasting model. The T_2FTS model was used to exploit more information in time series forecasting. The concepts of sliding window method (SWM) and fuzzy rule-based systems (FRBS) were incorporated in the utilization of T_2FTS to obtain forecasting values. A sliding window method was proposed to find a proper and systematic measurement for predicting the number of class intervals. Furthermore, the weighted subsethood-based algorithm was applied in developing fuzzy IF–THEN rules, where it was later used to perform forecasting. This approach provides inferences based on how people think and make judgments. In this research, the data sets from previous studies of crude palm oil prices were used to further analyze and validate the proposed model. With suitable class intervals and fuzzy rules generated, the forecasting values obtained were more precise and closer to the actual values. The findings of this paper proved that the proposed forecasting method could be used as an alternative for improved forecasting of sustainable crude palm oil prices.

Keywords: fuzzy time series; reasoning-based model; sliding window method; type 2 fuzzy time series; weighted subsethood-based algorithm

1. Introduction

There are a number of ways to obtain forecast value in the analysis of time series [1] such as artificial intelligence approaches [2], artificial neural network (ANN) [3,4] and autoregressive integrated moving average (ARIMA) models [1,5]. According to [6], the selection of the methods must reflect several features such as data and degree of significance. Nevertheless, most of the previous models are quite costly and require expertise and several data types that are occasionally unobtainable.

The fuzzy time series (FTS) method was widely used in different applications to solve forecasting problems. It was discussed in many types of research [7–9] such as in weather forecasting, stock fluctuations, and any situation in which variables change unpredictability over time. As the issues on forecasting with data on past events are linguistic values, the common method of time series forecasting methods is not relevant to be used [10]. FTS has been improved by many researchers to produce the most ideal forecasting outcomes [11]. The studies in [12–14] suggested time-variant and time-invariant FTS models in forecasting and their observations are in terms of linguistics values. In addition, the research in [15,16] used a simple arithmetic operation instead of complicated maximum and minimum composition operations in time series forecasting. Thereafter, many previous research works were revealed to reduce forecasting error and computational overload.